FLOOD PREDICTION ANALYSIS FOR LAGOS STATE, NIGERIA.

Analyzing Weather Conditions to Predict Potential Flooding Events.

6th of July 2024.

Executive Summary

Flooding has emerged as a perennial issue in Lagos, Nigeria. This report aims to analyze weather conditions to predict potential flooding events.Using a dataset that includes key weather variables such as precipitation, windspeed, sea level pressure, and wind direction. The analysis was conducted using time series forecasting in Power BI to model the relationship between these weather parameters and flooding incidents.

Introduction

Flooding is a recurrent natural disaster in Lagos State, exacerbated by heavy rainfall during the rainy season (April to October). This report aims to predict potential flooding events using weather data, helping to improve flood preparedness and risk management.

Data Collection and Preparation

Weather data was collected, including temperature, humidity, precipitation, windspeed, sea level pressure, and wind direction. The data was cleaned and pre-processed, with missing values handled and appropriate data types assigned.

Methodology

This section outlines the methodology used to forecast potential flooding events in Lagos State, leveraging time series forecasting in Power BI. The steps involved in the data preparation, analysis, and forecasting processes are described in detail below.

Data Preparation

1. **Creating a Date Table:**
    - A Date Table was created to facilitate time series forecasting. This table includes columns for the date, year, month, day, and other necessary date-related features. The Date Table is essential for accurate time series analysis and ensures proper alignment of the time-based data.
2. **Data Selection:**
    - Although the dataset originally spans from 2009 to 2024, only data from 2020 to 2024 was used to get the average min and max values used for this analysis. This decision was made to ensure the accuracy of the forecast, as it was observed that data consistency and reliability were better in the more recent years.
    - It was noted that the dataset had inconsistencies, with different values for the same periods in different datasets, highlighting the issue of improper data maintenance.
3. **Data Cleaning:**
    - The dataset was cleaned to remove any anomalies, missing values, or outliers that could skew the analysis. Ensuring clean data is crucial for accurate forecasting.

Time Series Forecasting

1. **Forecasting Parameters:**
    - The following parameters were used for the time series forecasting of each weather variable:
        - Units: Months
        - Forecast Length: 29
        - Ignore the Last: 24
        - Seasonality: 29
        - Confidence Level: 95%
    - These parameters were chosen to match the seasonal patterns observed in the data and to provide a robust forecast.
2. **Forecasted Variables:**
    - The weather variables forecasted include:
        - Precipitation
        - Windspeed
        - Sea Level Pressure
        - Wind Direction
3. **Analysis of Forecast Results:**
    - For each forecasted weather variable, the average, maximum, and minimum values were identified. These statistics were used as a benchmark to interpret the forecast results and to predict potential flooding events.

Visualization

These first four visuals shows the averages, max and min values of the weather matrices

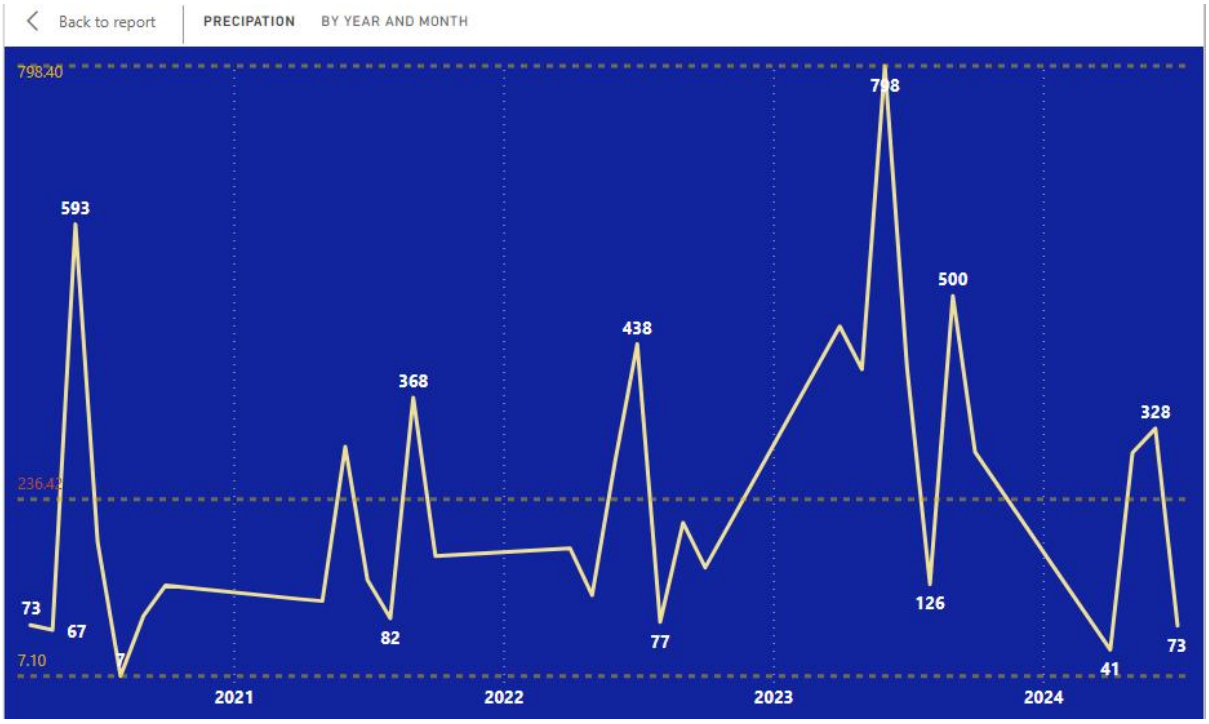

Fig1. Precipitation

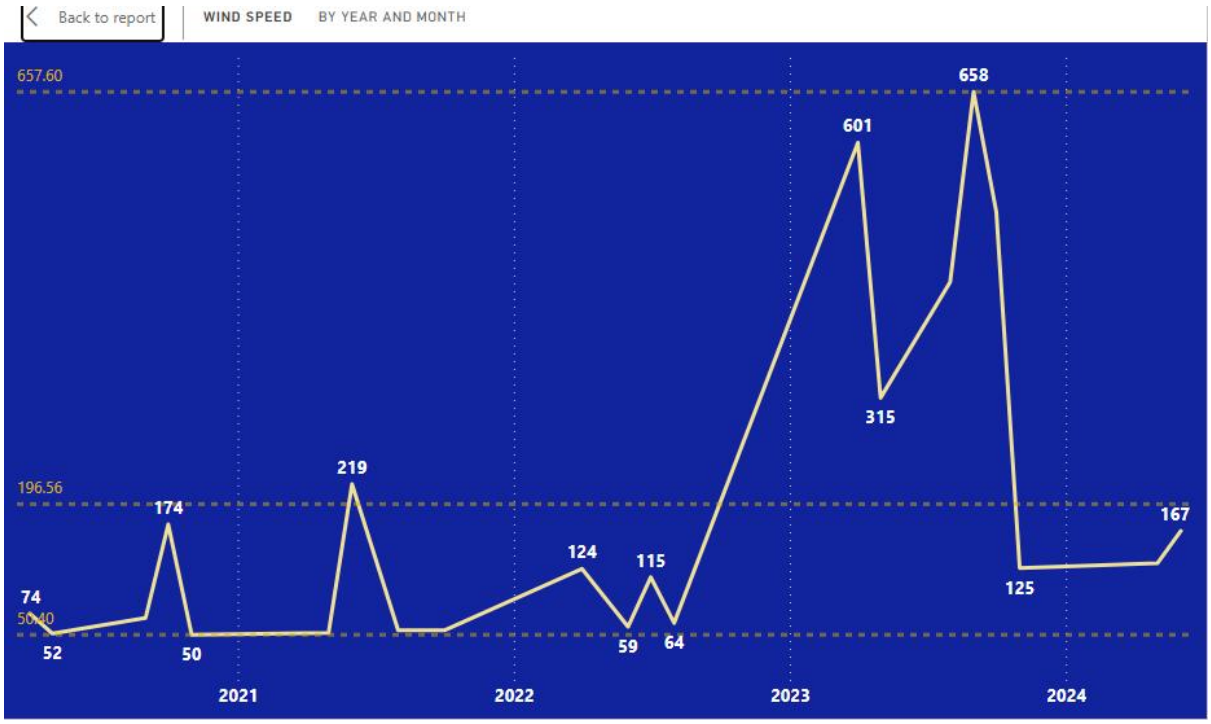

Fig2 wind speed

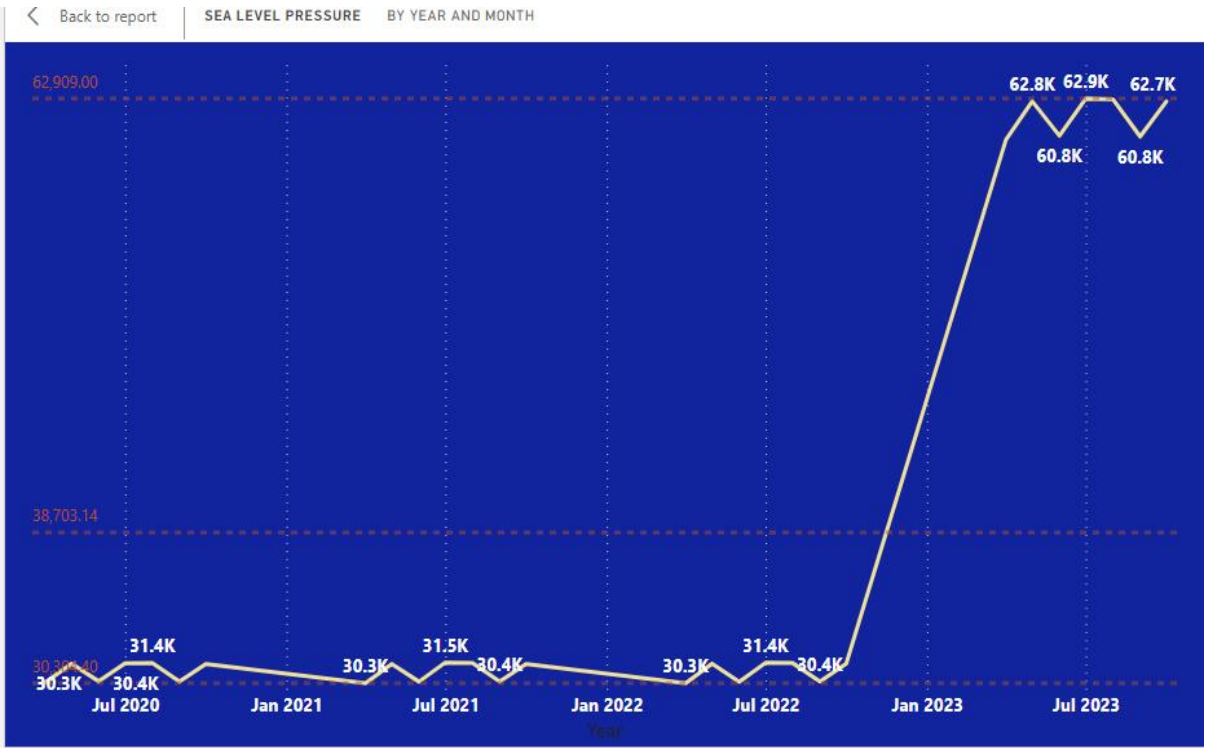

Fig3 sea level pressure

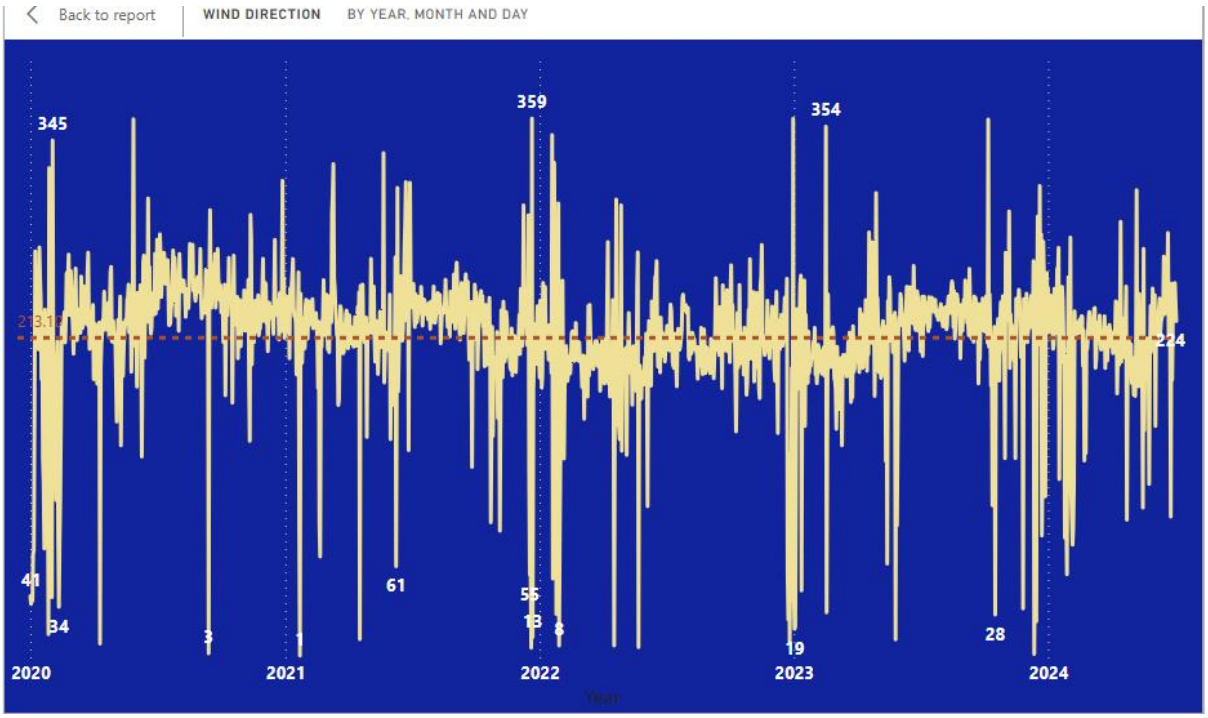

Fig 4 wind direction

The visuals below are the forecast for the various weather matrices

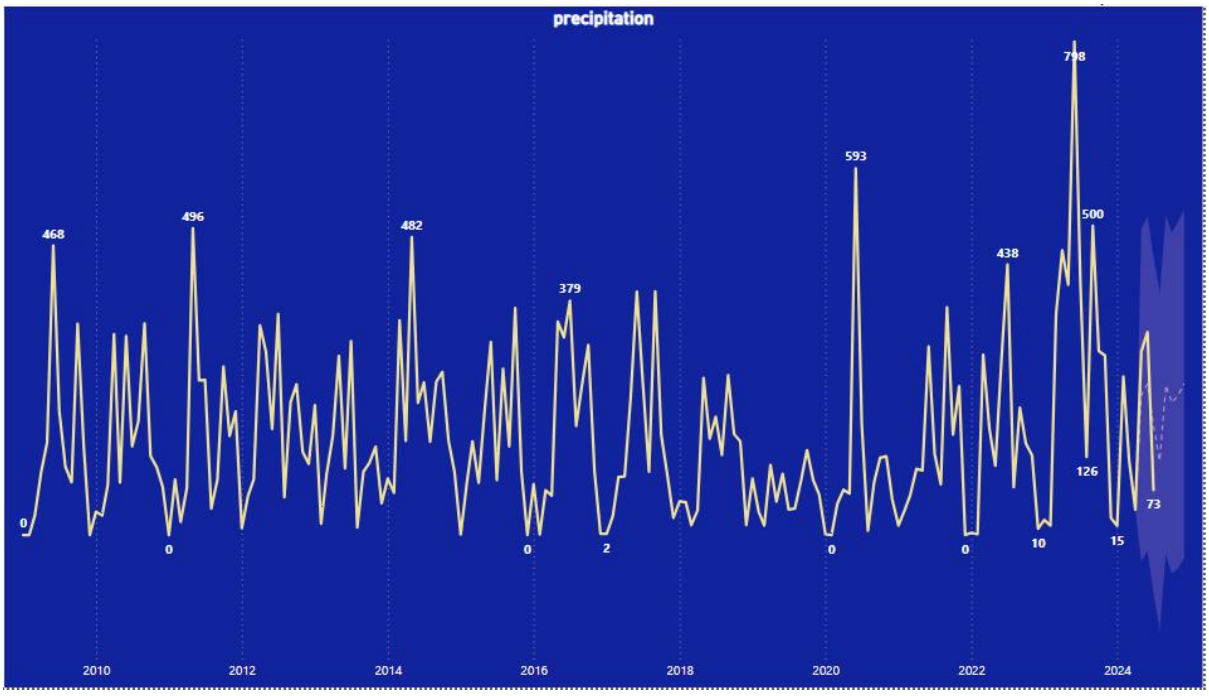

Fig5 precipitation

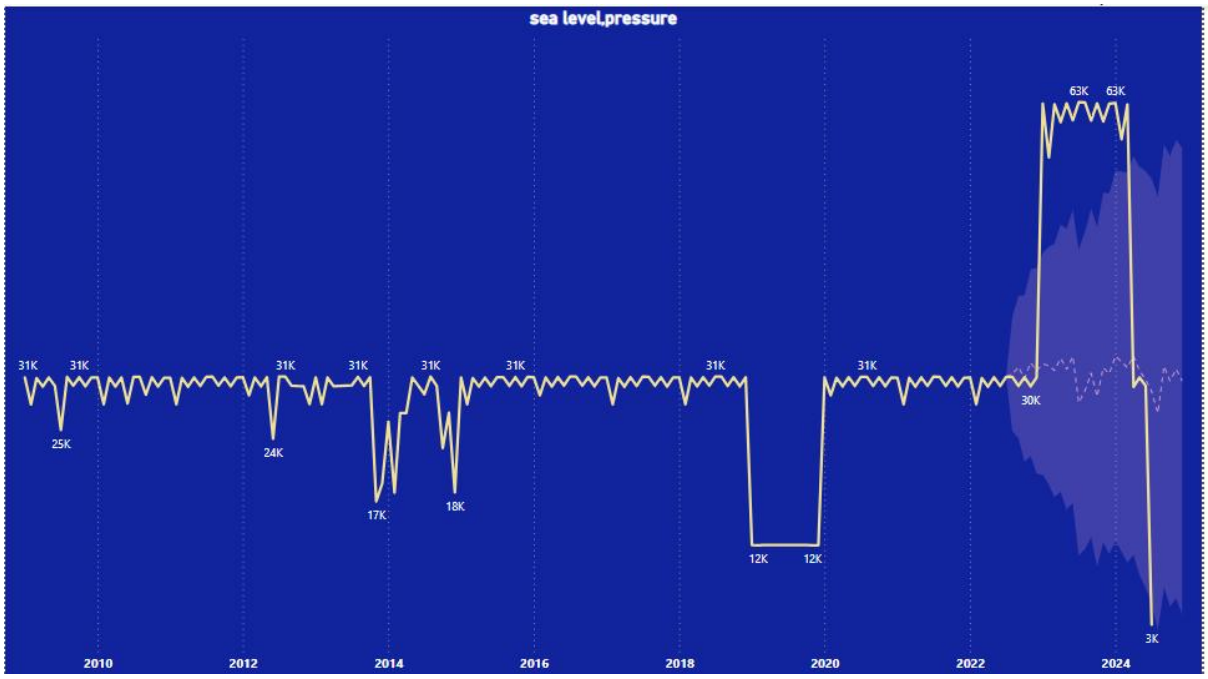

Fig6 sea level pressure

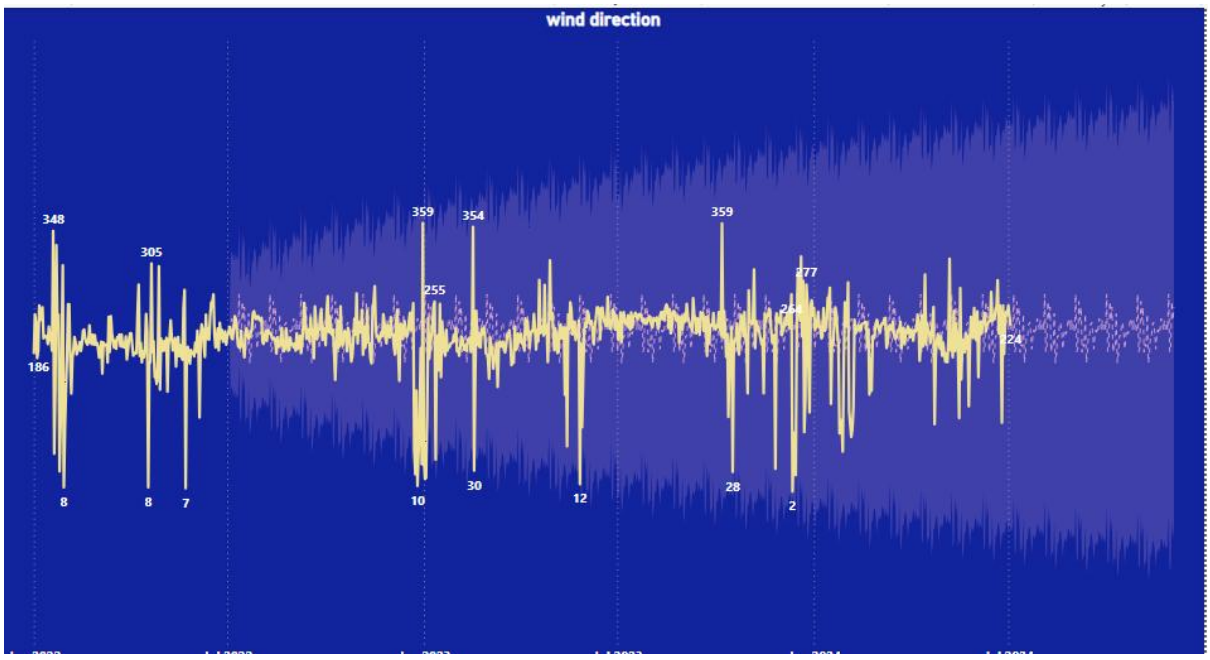

Fig7 wind direction

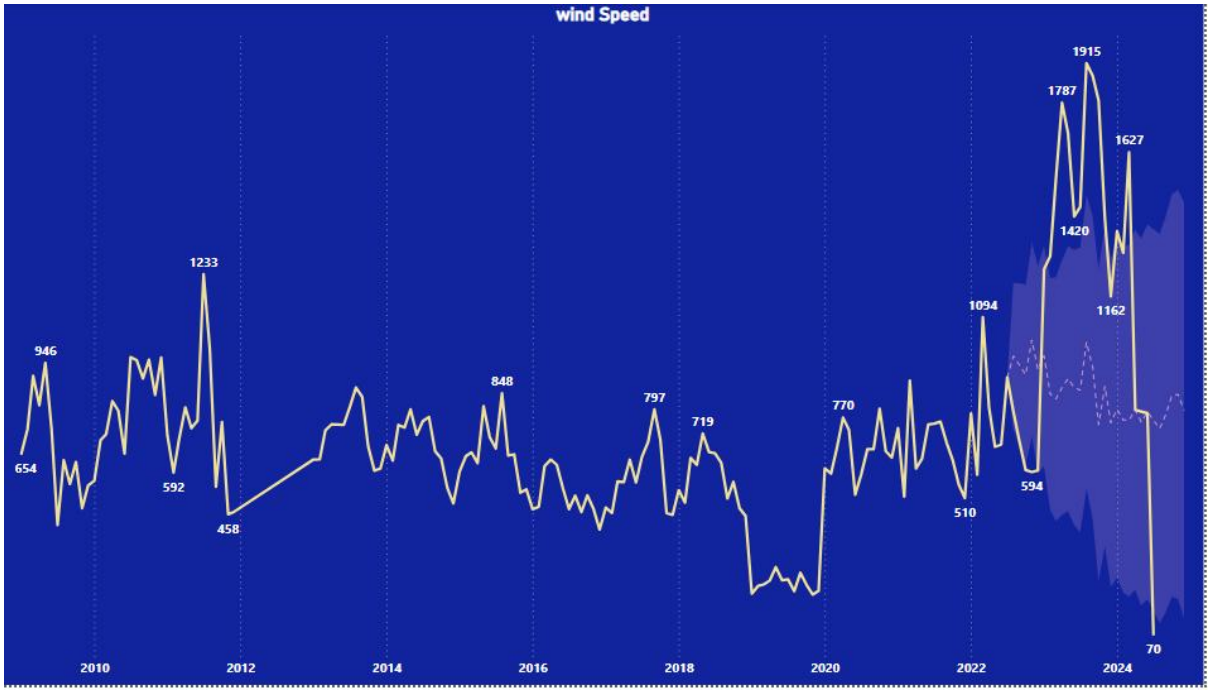

Fig8 wind speed

Results Interpretation

- The forecasted values for each weather variable were compared against the historical averages, maximums, and minimums to assess the likelihood of flooding. For example, high precipitation levels combined with high windspeed and specific wind directions (southeasterly winds) were indicators of increased flood risk.
- The forecast results for the key months during the rainy season (April to October) were analysed in detail to identify the months with the highest flood risk.

To determine which month is most likely to experience flooding based on the provided forecast values for precipitation, wind speed (wind speed above 47 can be classified as storm), sea level pressure, and wind direction, we need to consider the factors that significantly contribute to flooding:

1. **Precipitation**: High precipitation increases the likelihood of flooding.
2. **Windspeed**: High wind speeds can contribute to tidal surges, especially when they exceed 50, which can exacerbate flooding.
3. **Sea Level Pressure**: Lower Sea level pressure can indicate storm conditions, contributing to higher flood risk.
4. **Wind Direction**: Wind flowing southeasterly can push water into the lagoon, increasing flood risk.

Analysis of Forecast Values:

Month of July:

- Precipitation forecast: 177.05 (upper bound: 448.75, lower bound: -94.64)
- Windspeed forecast: 761.72 (upper bound: 1378.47, lower bound: 144.97)
- Sea level pressure forecast: 29,758.83 (upper bound: 54,132.47, lower bound: 5385)
- Wind direction forecast: 184.46 (upper bound: 455.34, lower bound: -86.42)

Month of August:

- Precipitation forecast: 119.88 (upper bound: 392.90, lower bound: -153.15)
- Windspeed forecast: 734.89 (upper bound: 1362.96, lower bound: 106.82)
- Sea level pressure forecast: 27,283.06 (upper bound: 52,143, lower bound: 2422)
- Wind direction forecast: 173.42 (upper bound: 448.83, lower bound: 101.99)

Month of September:

- Precipitation forecast: 242.37 (upper bound: 516.72, lower bound: -31.97)
- Windspeed forecast: 780.33 (upper bound: 1419.52, lower bound: 141.14)
- Sea level pressure forecast: 32,673 (upper bound: 58,012.14, lower bound: 7335.30)
- Wind direction forecast: 173.42 (upper bound: 453.43, lower bound: -106.59)

Month of October:

- Precipitation forecast: 213.79 (upper bound: 489.45, lower bound: -61.87)
- Windspeed forecast: 841.15 (upper bound: 1491.28, lower bound: 191.02)
- Sea level pressure forecast: 30,957.66 (upper bound: 56,764.95, lower bound: 5150)
- Wind direction forecast: 173.42 (upper bound: 457.95, lower bound: -111.11)

Month of November:

- Precipitation forecast: 226.28 (upper bound: 507.09, lower bound: -54.53)
- Windspeed forecast: 845.08 (upper bound: 1505.96, lower bound: 184.20)
- Sea level pressure forecast: 32,312.27 (upper bound: 58,580.06, lower bound: 6004.47)
- Wind direction forecast: 192.99 (upper bound: 480.87, lower bound: 94.89)

Conclusion:

Considering the factors involved, the month of **October(presumably first and second week)** appears to have the highest risk of flooding. This conclusion is based on the following observations:

1. **High Windspeed**: October has the highest forecasted windspeed (841.15) with a high upper bound (1491.28), indicating strong winds capable of causing tidal surges.
2. **Significant Precipitation**: The precipitation forecast for October is also high (213.79), with an upper bound of 489.45.
3. **Low Sea Level Pressure**: Although not the lowest, October's sea level pressure forecast is relatively low (30,957.66), which can be indicative of storm conditions.

4. **Southeasterly Wind Direction**: The wind direction forecast for October (173.42) suggests a wind direction that can push water into the lagoon, increasing flood risk.

While other months also show high values for certain factors, the combination of high windspeed, significant precipitation, and southeasterly wind direction makes October the most likely month to experience flooding.